Name: ..... Register no: ..... Class: .....

NGEE ANN SECONDARY SCHOOL NA

PRELIMINARY EXAMINATION

SCIENCE CHEMISTRY 5105/03, 5105/04

17 August 2023

1 h 15 min

Additional Materials: Optical Answer Sheet (OAS)

Instructions to Candidates

Write your name, register number and class at the top of this page.
Write in dark blue or black pen.
You may use pencil for any diagrams, graphs, tables or rough working.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.
If the degree of accuracy is not specified in the question, give the answer to three significant figures.

Paper 3 (Multiple Choice Questions)
Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in the Optical Answer Sheet provided.

Paper 4 - Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Paper 4 - Section B
Answer **any two** questions.
Write your answers in the spaces provided on the question paper.

For Examiner's Use

Section	Marks
Paper 3	/20
Paper 4 – Section A	/14
Paper 4 – Section B	/16
Total	/50

Check by student: _____ Date: _____

This document consists of 16 printed pages and 0 blank pages.

The Periodic Table of Elements

Group																	
I	**II**											**III**	**IV**	**V**	**VI**	**VII**	**0**
							1 **H** hydrogen 1										2 **He** helium 4
3 **Li** lithium 7	4 **Be** beryllium 9		Key: proton (atomic) number, **atomic symbol**, name, relative atomic mass									5 **B** boron 11	6 **C** carbon 12	7 **N** nitrogen 14	8 **O** oxygen 16	9 **F** fluorine 19	10 **Ne** neon 20
11 **Na** sodium 23	12 **Mg** magnesium 24											13 **Al** aluminium 27	14 **Si** silicon 28	15 **P** phosphorus 31	16 **S** sulfur 32	17 **Cl** chlorine 35.5	18 **Ar** argon 40
19 **K** potassium 39	20 **Ca** calcium 40	21 **Sc** scandium 45	22 **Ti** titanium 48	23 **V** vanadium 51	24 **Cr** chromium 52	25 **Mn** manganese 55	26 **Fe** iron 56	27 **Co** cobalt 59	28 **Ni** nickel 59	29 **Cu** copper 64	30 **Zn** zinc 65	31 **Ga** gallium 70	32 **Ge** germanium 73	33 **As** arsenic 75	34 **Se** selenium 79	35 **Br** bromine 80	36 **Kr** krypton 84
37 **Rb** rubidium 85	38 **Sr** strontium 88	39 **Y** yttrium 89	40 **Zr** zirconium 91	41 **Nb** niobium 93	42 **Mo** molybdenum 96	43 **Tc** technetium -	44 **Ru** ruthenium 101	45 **Rh** rhodium 103	46 **Pd** palladium 106	47 **Ag** silver 108	48 **Cd** cadmium 112	49 **In** indium 115	50 **Sn** tin 119	51 **Sb** antimony 122	52 **Te** tellurium 128	53 **I** iodine 127	54 **Xe** xenon 131
55 **Cs** caesium 133	56 **Ba** barium 137	57 – 71 lanthanoids	72 **Hf** hafnium 178	73 **Ta** tantalum 181	74 **W** tungsten 184	75 **Re** rhenium 186	76 **Os** osmium 190	77 **Ir** iridium 192	78 **Pt** platinum 195	79 **Au** gold 197	80 **Hg** mercury 201	81 **Tl** thallium 204	82 **Pb** lead 207	83 **Bi** bismuth 209	84 **Po** polonium -	85 **At** astatine -	86 **Rn** radon -
87 **Fr** francium -	88 **Ra** radium -	89 – 103 actinoids	104 **Rf** rutherfordium -	105 **Db** dubnium -	106 **Sg** seaborgium -	107 **Bh** bohrium -	108 **Hs** hassium -	109 **Mt** meitnerium -	110 **Ds** darmstadtium -	111 **Rg** roentgenium -	112 **Cn** copernicium -		114 **Fl** flerovium -		116 **Lv** livermorium -		

lanthanoids	57 **La** lanthanum 139	58 **Ce** cerium 140	59 **Pr** praseodymium 141	60 **Nd** neodymium 144	61 **Pm** promethium -	62 **Sm** samarium 150	63 **Eu** europium 152	64 **Gd** gadolinium 157	65 **Tb** terbium 159	66 **Dy** dysprosium 163	67 **Ho** holmium 165	68 **Er** erbium 167	69 **Tm** thulium 169	70 **Yb** ytterbium 173	71 **Lu** lutetium 175
actinoids	89 **Ac** actinium -	90 **Th** thorium 232	91 **Pa** protactinium 231	92 **U** uranium 238	93 **Np** neptunium -	94 **Pu** plutonium -	95 **Am** americium -	96 **Cm** curium -	97 **Bk** berkelium -	98 **Cf** californium -	99 **Es** einsteinium -	100 **Fm** fermium -	101 **Md** mendelevium -	102 **No** nobelium -	103 **Lr** lawrencium -

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

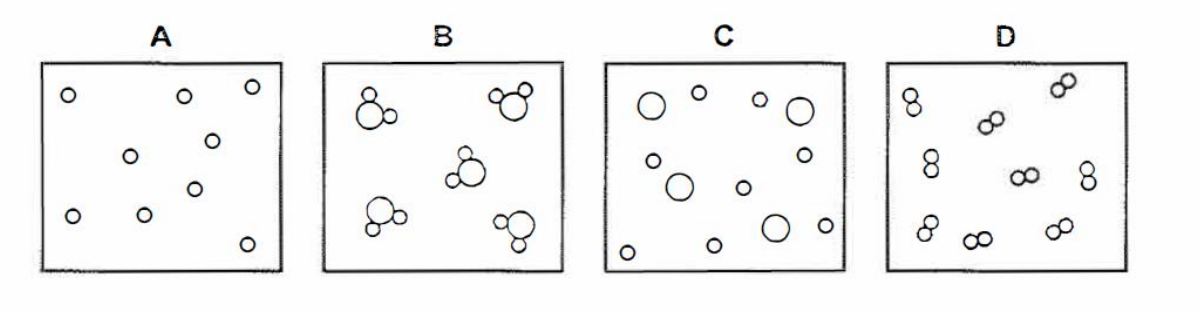
Paper 3: Section A: Multiple Choice Questions [20 marks]

Record your answers on the separate Optical Answer Sheet (OAS) provided.

1. In the diagrams, each circle represents an atom.

   Different sized circles represent different atoms.

   Which diagram represents a mixture?



2. A student wishes to add exactly 11.65 cm^3 of acid to exactly 25.0 cm^3 of an alkali as part of an experiment.

   Which apparatus should the student use to measure these volumes?

	acid	alkali
A	pipette	burette
B	burette	measuring cylinder
C	burette	pipette
D	measuring cylinder	pipette

3. Which of the following contains mixtures only?

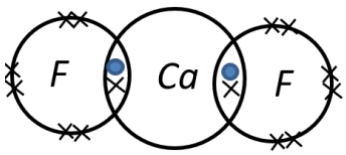
   A air and sugar
   B calcium hydroxide and water
   C carbon monoxide and air
   D sea water and brass

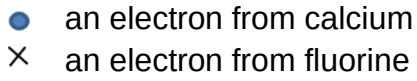
4. What happens when ice melts?

   A Covalent bonds in a giant lattice are broken.
   B Electrons are released from atoms.
   C Intermolecular forces of attraction are overcome.
   D Molecules are separated into ions.

5. Which diagram shows the outer electron arrangement in calcium fluoride?

A





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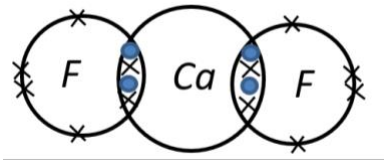

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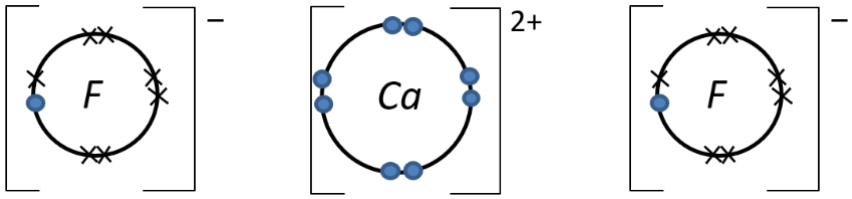

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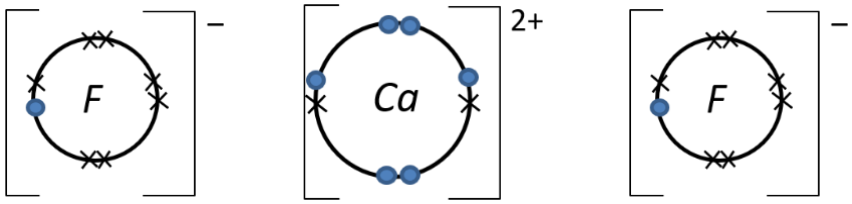


6. An **excess** of calcium hydroxide is added to an acidic soil.
What happens to the pH of the soil?

	change in pH	final pH
A	decrease	5
B	decrease	12
C	increase	7
D	increase	12

7. Aqueous solution **X** is added to aqueous ammonium chloride.
The mixture is heated and ammonia gas is given off.

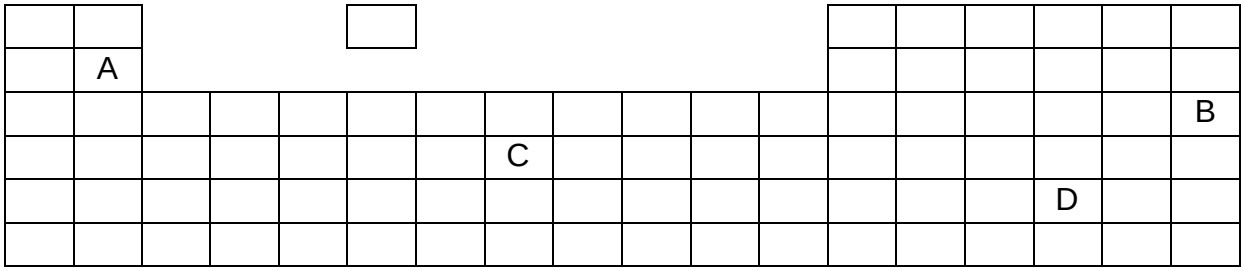
What is **X**?

A ammonium sulfate
B hydrochloric acid
C sodium chloride
D sodium hydroxide

8. Which one of the following is an amphoteric oxide?

   A carbon dioxide
   B copper(II) oxide
   C sulfur dioxide
   D aluminium oxide

9. An atom of element **R** has an electronic structure of 2,8,6.
   The positions in the Periodic Table of four elements are shown.
   Which element will have properties most similar to **R**?



10. Three elements each have two valence electrons.

    Which statement about the elements is correct?

    A They are all metallic and belong to the same group of the Periodic Table.
    B They are all metallic but belong to different groups of the Periodic Table.
    C They are all non-metallic and belong to the same group of the Periodic Table.
    D They are all non-metallic but belong to different groups of the Periodic Table.

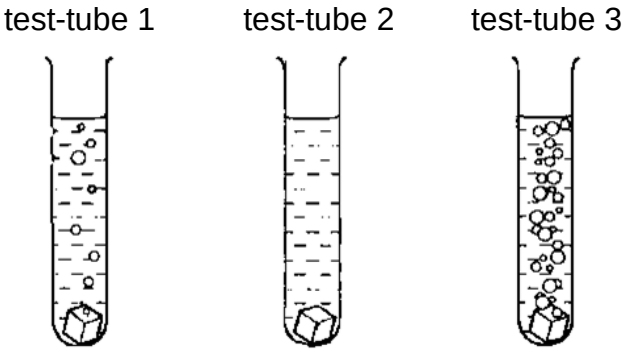
11. The relative atomic mass of chlorine is 35.5. What is the mass of 1.5 moles of chlorine gas?

    A 35.5 g
    B 71.0 g
    C 106.5 g
    D 142 g

12. What is the relative formula mass, M_r, of ammonium sulfate, $(NH_4)_2SO_4$?

    A 70
    B 114
    C 132
    D 216

13. Pieces of silver, iron and calcium, of the same size and shape, are added to dilute hydrochloric acid.
The diagram shows the results.



Which metal was placed in each test-tube?

	test-tube 1	test-tube 2	test-tube 3
A	iron	silver	calcium
B	iron	calcium	silver
C	calcium	silver	iron
D	silver	iron	calcium

14. Which statement about recycling of metals is **not** correct?

A Recycling enables the finite metal resources to last longer.
B Recycling saves the cost of extracting new metals from ores.
C Recycling reduces rubbish at landfills.
D Recycling strengthens the structure of the metals recycled.

15. Which of the following shows the correct order of the amounts of the various gases in clean air?

	most abundant	→	least abundant
A	nitrogen	carbon dioxide	oxygen
B	nitrogen	oxygen	carbon dioxide
C	oxygen	nitrogen	carbon dioxide
D	oxygen	carbon dioxide	nitrogen

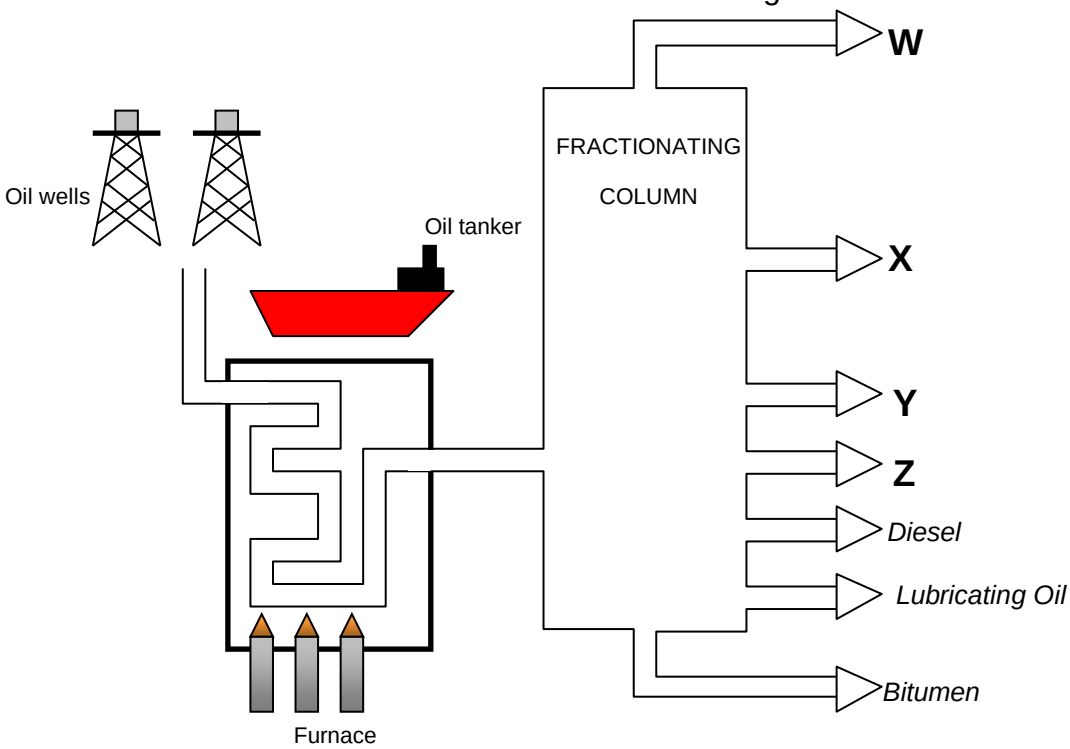
16. Which reaction is an example of the cracking of an alkane?

A $3C_2H_4 \rightarrow C_6H_{12}$
B $C_6H_{12} + H_2 \rightarrow C_6H_{14}$
C $C_7H_{16} \rightarrow 7C + 8H_2$
D $C_7H_{16} \rightarrow C_3H_6 + C_4H_{10}$

17. Which equation represents the complete combustion of methane in oxygen?

A $2CH_4(g) + 3O_2(g) \rightarrow 2CO(g) + 4H_2O(g)$
B $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$
C $CH_4(g) + O_2(g) \rightarrow C(s) + 2H_2O(g)$
D $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2(g)$

18. Which is the correct order, starting from the lowest boiling point, for the different fractions of crude oil to be distilled off in the fractionating column below:

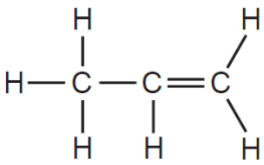


	W	X	Y	Z
A	petroleum gas	naphtha	petrol	kerosene
B	petroleum gas	naphtha	kerosene	petrol
C	petroleum gas	petrol	naphtha	kerosene
D	kerosene	naphtha	petroleum gas	petrol

19. Which statement describes a homologous series?

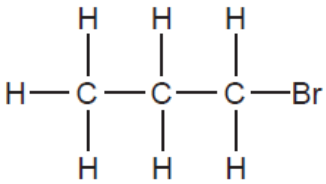
A All compounds have the same physical properties.
B All compounds have the same general formula.
C All compounds have the same relative molecular mass.
D All compounds have the same structural formula.

20. Propene is an unsaturated hydrocarbon. Its structure is shown.



What is produced when propene reacts with bromine?

A



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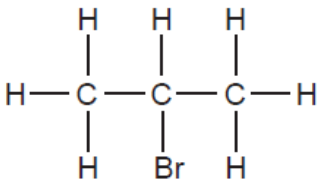

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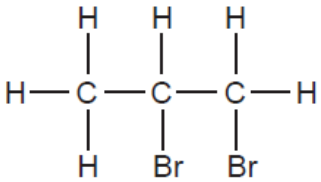
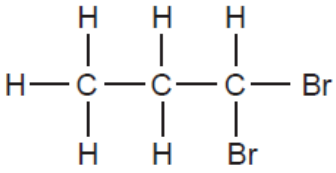


D



--End of Paper 3--

Paper 4: Section A: Structured Questions [14 marks]

Answer **all** the questions in the spaces provided.

1. The table shows the atomic structure of five particles, represented by letters **R** to **V**. The particles are atoms or ions. The letters are not symbols of the elements.

particle	electron	proton	neutron
R	6	6	6
S	2	2	2
T	9	9	10
U	10	12	12
V	10	13	14

Use letters **R** to **V** to answer the following questions. [3]

a) Identify **two** particles that are ions ……....

b) Identify the particle that belongs to Group 0 ……..……...

c) A student suggested that particle **U** and **V** are isotopes. Do you agree with the student? Explain why.

……

……

……

2. Oxygen reacts with both metals and non-metals to form different substances. The table below shows the melting point of the substances.

substance	**type of bonding present**	**melting point/°C**
O_2		-219
MgO		2852
CO_2		-55.6

a) Complete the table above. [1]

b) Draw a 'dot and cross' diagram to show the arrangement of all electrons in magnesium oxide, MgO. [2]

c) In terms of bonding and structure, explain why oxygen, O_2, and carbon dioxide, CO_2, have a low melting point. [2]

……

……

……

3. Element **X** forms a basic oxide with the formula $\mathbf{X}_2O$. It was determined that 0.200 mol of $\mathbf{X}_2O$ has a mass of 12.4 g.

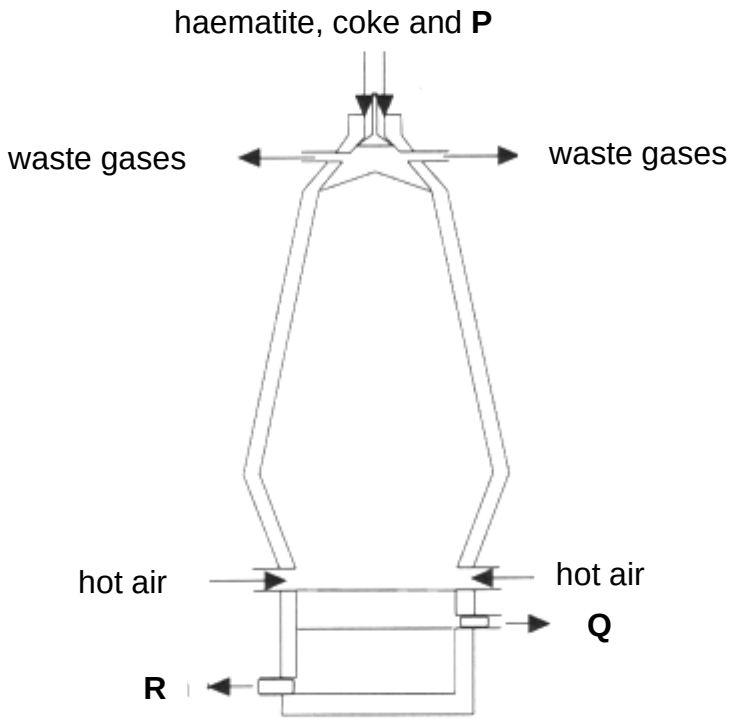
   a) Determine the relative formula mass, M_r, of $\mathbf{X}_2O$. [1]
   Show your working.
   [A_r: O, 16]

   b) Determine the relative atomic mass, A_r, of element **X**. [1]
   Show your working.

   c) Hence, suggest an identity of element **X**. [1]

   X is ……

4. Iron is extracted in a blast furnace as shown in the diagram below.



a) Name the following substances. [2]

P: ……

Q: ……

R: ……

b) State the purpose of adding **P** into the blast furnace. [1]

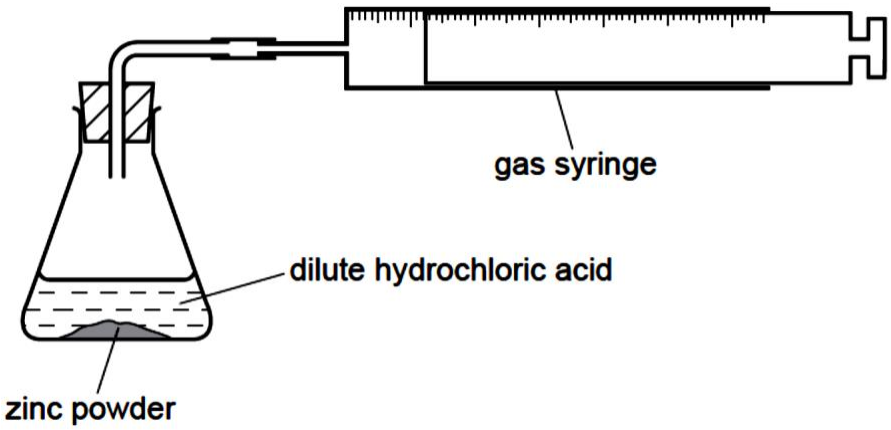
……

……

Section B [16 marks]

Answer any **two** questions from this section in the spaces provided.

5. Soluble zinc chloride salt is formed by reacting hydrochloric acid with **excess** zinc powder using the apparatus shown below.



The volume of gas produced was measured every minute for six minutes.
The results are shown in the table below.

Time/ min	0	1	2	3	4	5	6
Volume of gas collected/ cm^3	0	17	23	40	48	54	57

a) Write a balanced chemical equation, including state symbols, for the reaction between zinc powder and hydrochloric acid. [2]

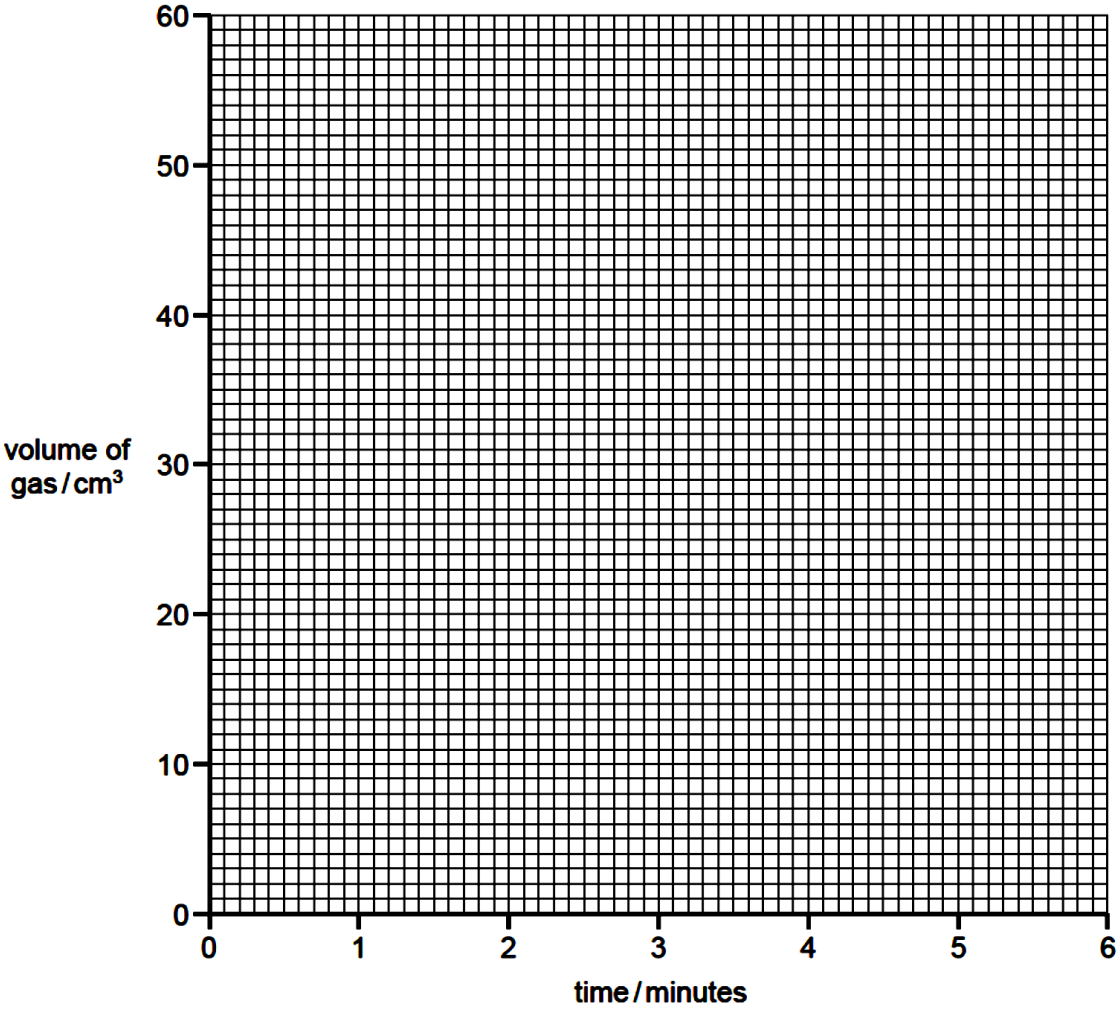
……

b) Suggest a test to confirm the identity of the gas collected. [2]

Test: ……

Observation: ……

c) Plot the results on the grid below and draw a smooth line graph. [2]



d) (i) At which time does the results appear to be inaccurate? [1]

……

(ii) Use the graph to work out the volume of gas that should be recorded at this time in (d)(i). [1]

Volume of gas that should be recorded = ……..… cm^3

6. Ethane and ethene are hydrocarbons. Information about ethane and ethene are shown below.

homologous series	name	full structural formula
alkanes	ethane	
alkenes	ethene	

a) Complete the table above. [2]

b) Ethane is a ***saturated*** hydrocarbon and ethene is an ***unsaturated*** hydrocarbon. Explain what is meant by the terms ***saturated***, ***unsaturated*** and ***hydrocarbon***. [3]

saturated ……..……..

……

unsaturated ……..…….

……

hydrocarbon ……..……

……

c) Name a chemical reagent that can be used to show the difference between a saturated and an unsaturated hydrocarbon.

Describe what you would observe when this reagent is added to separate samples of ethane and ethene. [3]

Reagent ……..….

Observation with ethane ……

……

Observation with ethene ……

……

7. The halogens, fluorine, chlorine, bromine and iodine, are in Group VII of the Periodic Table.

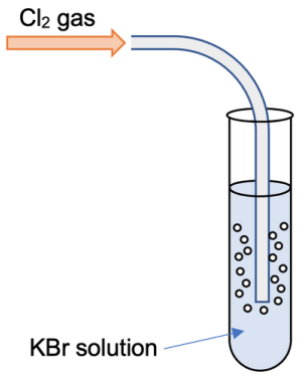
a) Use the Periodic Table to identify and name another halogen. [1]

……..

b) Suggest if the halogen named in a) is more or less reactive than fluorine. [1]

……..

c) Chlorine gas displaces bromine from potassium bromide solution.



(i) Write a balanced chemical equation for the reaction. [1]

……

(ii) Suggest an explanation for the reaction. [2]

……

……

……

d) Potassium is a metal with symbol **K** and atomic number 19. It is classified as an alkali metal, and it is a solid at room temperature, but it is soft and can be cut with a knife.

(i) Why is potassium classified as an alkali metal? [1]

……

(ii) Explain why potassium is soft and can be cut with a knife. [2]

……

……

--End of Paper--

2023 4NA Science Chemistry Prelim

Suggested Answers

1	2	3	4	5	6	7	8	9	10
C	C	D	C	C	D	D	D	D	A
11	12	13	14	15	16	17	18	19	20
C	C	A	D	B	D	B	C	B	C

Paper 4: Section A: Structured Questions [14 marks]

Answer **all** the questions in the spaces provided.

1.

a) Identify **two** particles that are ions **U, V [1]**

b) Identify the particle belonging to the noble gas group **S [1]**

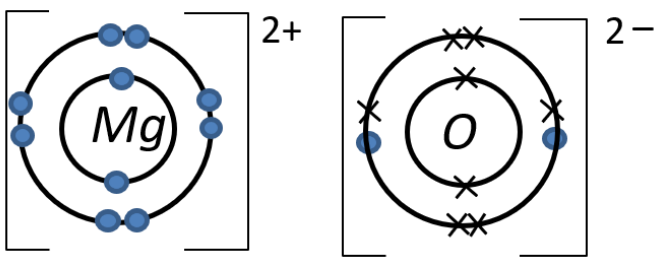
c) A student suggested that particle **U** and **V** are isotopes. Do you agree with the student? Explain why.
No they do not, isotopes have the same proton number and different number of neutron. U & V do not have the same proton number. [1]

2a.

	type of bonding present	melting point/°C
O_2	**Covalent bonding**	-219
MgO	**Ionic bonding**	2852
CO_2	**Covalent bonding**	-55.6

[1]

b)



[2]

c) both oxygen and carbon dioxide exist as simple, discrete molecules. [1] The molecules are held together by weak intermolecular forces of attraction. Less energy is required to overcome the weak intermolecular forces of attraction. Hence, both have low melting points. [1]

3)

a) Calculate the relative formula mass of $\mathbf{X}_2O$. [1]

relative formula mass = mass/mole
= 12.4/0.2
= 62.0

b) Calculate the relative atomic mass of element **X**. [1]

relative atomic mass = (62 – 16)
= 23.0

c) Hence, suggest an identity for element **X**. [1]
X is **sodium**

4)

a)

P: **limestone**

Q: **molten slag / slag**

R: **molten iron / iron** [1]

b) State the purpose of adding **P** into the blast furnace. [1]

Limestone is added to produce CaO to remove acidic impurities (SiO_2).

5)

a) Write a balanced chemical equation, including state symbols for the reaction between zinc powder and hydrochloric acid. [2]

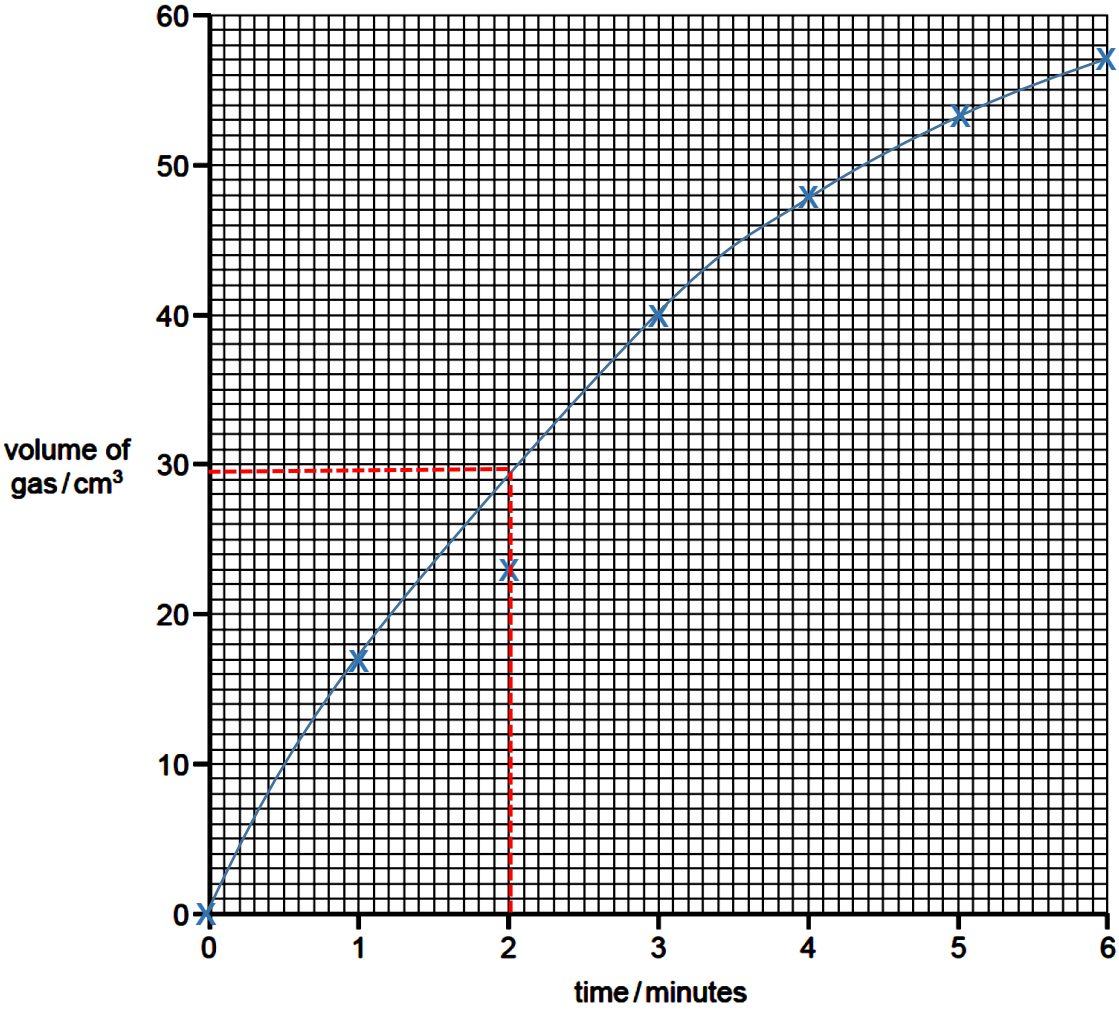
$Zn\ (s) + 2\ HCl\ (aq) \rightarrow ZnCl_2\ (aq) + H_2\ (g)$

b) Suggest a test to confirm the identity of the gas collected. [2]

Test: **Use a lighted splint**

Observation: **Lighted splint extinguishes with a pop sound**

c) Plot the results on the grid below and draw a smooth line graph. [2]



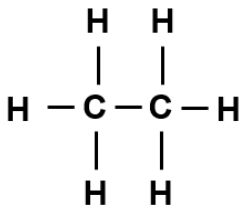
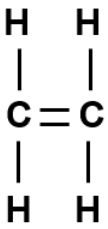
d) (i) At which time does the results appear to be inaccurate? [1]

2 minutes

(ii) Use the graph to work out the volume of gas that should be recorded at this time. [1]

Volume of gas that should be recorded = **Between 29.0 to 30.0 (accept answers according to student's graph)**

6. Ethane and ethene are hydrocarbons and information about ethane and ethene are as shown below.

Homologous series	Name of member with 2 carbons	Full structural formula
Alkanes	Ethane	
Alkenes	Ethene	

d) Complete the table above. [2]

e) Ethane is a ***saturated*** hydrocarbon and ethene is an ***unsaturated*** hydrocarbon. Explain what is meant by the terms ***saturated***, ***unsaturated*** and ***hydrocarbon***. [3]

Saturated **it means that all the carbon – carbon are all single bonds.**

Unsaturated **it means that there is one carbon – carbon double bonds.**

Hydrocarbon **it means that it contains carbon and hydrogen atoms only**

f) Name a chemical reagent that can be used to show the difference between a saturated and an unsaturated hydrocarbon.

Describe what you would observe when this reagent is added to separate samples of ethane and ethene. [3]

Reagent **add aqueous bromine/bromine solution / bromine water**

Observation with ethane **aqueous bromine/bromine solution remains brown**
Observation with ethene **brown aqueous bromine/bromine solution turns colourless.**

1. The halogens, fluorine, chlorine, bromine and iodine, are in Group VII of the Periodic Table.

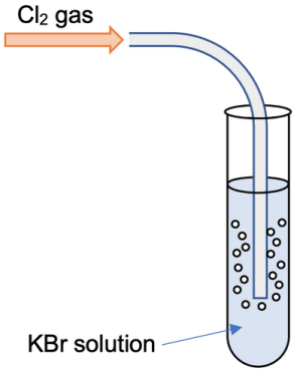
   a) Use the Periodic Table to identify and name another halogen. [1]

   Astatine

   b) Suggest if the halogen named in a) is more or less reactive than fluorine. [1]

   It is less reactive than fluorine

   c) Chlorine gas displaces bromine from potassium bromide solution.



   (i) Write a balanced chemical equation for the reaction. [1]

   Cl_2 + 2KBr → 2KC*l* + Br_2 **[1]**

   (ii) Suggest an explanation for the reaction. [2]

   Chlorine is more reactive than bromine. **[1]**

   Chlorine will displace bromine from KBr. **[1]**

   d) Potassium is a metal with symbol **K** and atomic number 19. It is classified as an alkali metal, and it is a solid at room temperature, but it is soft and can be cut with a knife.

   (i) Why is potassium classified as an alkali metal? [1]

   Potassium will react with water to form an alkali

   (ii) Explain why potassium is soft and can be cut with a knife. [2]

   The atoms in potassium are of the same size and are orderly arranged. When cut, they slide over each other easily.

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